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Sustainable mobility in Bucharest. An indicator-based assessment.

A short report to supplement the 2018 Ranking of European Cities in Sustainable Transport

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Disclaimer

This report is a complementary piece to the Wuppertal Institute's city ranking 2018 in the field of sustainable mobility ("Living. Moving. Breathing."; Kodukula et al. 2018). It is the result of research commissioned by Greenpeace in Central & Eastern Europe. The responsibility for the report's contents lies with the authors.

All pictures by courtesy of Stefan Roseanu.

Contents

1 Introduction

Transport is a key economic sector in Europe; transportation influences the opportunities of production and consumption. By improving access to markets, goods and services, employment, housing, health care, and education while reducing the cost of moving people and goods, transportation projects can increase economic productivity and development.

As being mobile means being able to access jobs, health care and recreation, mobility is also a prerequisite for inclusion. Most everyday trips take place in the boundaries of a city. The provision of access to basic services means to provide access to these with different transport modes. Many people are forced to or wish to live without access to a private car. Cities therefore strive to foster active modes. However, a large proportion of victims on urban roads are pedestrians and cyclists who do not pose risks to other road users but who are exposed to high risks created by motorised traffic (Engels 2019).

At the same time, emissions from the EU transport sector are not reducing enough to limit its environmental and climate impacts. Greenhouse gas (GHG) emissions from transport have increased over the last three years, whilst average CO_2 emissions of new passenger cars increased for the first time between 2017 and 2018. In Eastern Europe, motorisation and distances covered per person are increasing. The transport sector also remains a significant source of air pollution, especially of particulate matter (PM) and nitrogen dioxide, although these emissions have been reduced in the last decade (EEA 2018).

In order to tackle these challenges, cities usually pursue a strategy known as sustainable urban mobility planning. Its core goal is to improve accessibility and quality of life by achieving a shift towards sustainable mobility. Sustainable urban mobility planning advocates fact-based decision making guided by a long-term vision for sustainable mobility. As key components, this requires a thorough assessment of the current situation and future trends, a widely supported common vision with strategic objectives, and an integrated set of regulatory, promotional, financial, technical and infrastructure measures to deliver the objectives – whose implementation should be accompanied by systematic monitoring and evaluation (Rupprecht et al. 2019).

This report on urban mobility performance measurement is aimed at enabling stakeholders of the ***city of Bucharest*** and the public to understand their current urban mobility situation through a point-based results framework. It shall provide the city of Bucharest with a yardstick to measure its performance and benchmark the progress against some of its counterparts. It measures the urban mobility and compares it with 13 other European cities: Berlin, London, Vienna, Brussels, Moscow, Rome, Zurich, Paris, Amsterdam, Copenhagen, Oslo, Budapest and Madrid.

Similar to many other European cities, Bucharest employs a Sustainable Urban Mobility Plan (SUMP) in order to continuously improve urban transport and mobility and to make it more sustainable. In this respect, the report should also be regarded as a document which supports the stakeholders in Bucharest in their efforts to develop transport and mobility in the city more sustainable.

The city of Bucharest is the capital and largest city of Romania, as well as its cultural, economic, and financial centre. It is home to around 1.8 million people, with an area of about 228 km². The urban density of Bucharest is about 8,000 people per km², making it a quite dense European capital.

In the following, this report will discuss the state of mobility in Bucharest in the fields of: Public Transport; Road Safety; Air Quality; Mobility Management; and Active Mobility. The performance of Bucharest in these five categories is compared to the other 13 European capitals based on points received per indicator used, as explained in the Methodology section (see below).

The report is a supplement to the report "Living. Moving. Breathing. Ranking of European Cities in Sustainable Transport." from the Wuppertal Institute, commissioned by Greenpeace (Kodukula et al. 2018). This report had compared the other 13 cities' urban transport and mobility performances. ***If the city of Bucharest had taken part to this original Ranking of European Cities in Sustainable Transport, it would have ranked 13th overall out of these 14 cities.***

The thematic chapters will not only discuss the ranking of Bucharest as compared to the other cities, but also point to areas of improvement. The ranking is a snapshot of the situation in 2019, and the aim is to provide city officials with some suggestions for future action. Many of the cities which Bucharest is compared to in this report are well advanced with respect to sustainable mobility, such as Copenhagen and Amsterdam, which are known as the cycling capitals of Europe, or Vienna and Zurich, which are famous for their well-functioning public transport systems. By comparing Bucharest with these cities, this report also highlights best practice - details about other cities' best practice, however, can only be found in the original city ranking from 2018.

2 Methodology

This study depicts the methodology from the Wuppertal Institute's City Ranking 2018, which measured and evaluated the performance of sustainable mobility in 13 European capitals, namely Berlin, London, Vienna, Brussels, Moscow, Rome, Zurich, Paris, Amsterdam, Copenhagen, Oslo, Budapest and Madrid (Kodukula et al. 2018).

It compares Bucharest's sustainable mobility performance with these 13 cities without changing the original data and by using the most recent available data for Bucharest. That is, we did not search for recent data for the 13 cities in the original ranking and in consequence some indicators for Bucharest are newer than for the other cities. However, all data is assumed to be comparable, as the two studies lie apart only 1.5 years.

In measuring the performance of urban mobility, 21 indicators were selected and then divided further into five categories (see Table 2-1).

Tab. 2-1 City ranking indicators. Source: Wuppertal Institute methodology

Ranking category	Indicators used	Unit
Public transport	Share of public transport trips	Public transport modal share in %
	Cost of a single journey on public transport	Price of the minimum single journey ticket adjusted against cost of daily food (%)
	Annual trips per person	Annual trips / population
	Station density	Stations per km^2
Road safety	Bicycles fatalities	Fatalities/year
	Pedestrians fatalities	Fatalities/year
	Bicycle crashes	Crashes for every 1mn bicycle trips
	Pedestrian crashes	Crashes for every 1mn walking trips
Air quality (annual mean concentrations)	NO_2 / Nitrogen dioxide	$\mu g/m^3$
	PM 10 / particulate matter 10 µm	$\mu g/m^3$
	PM 2.5 / particulate matter 2.5 µm	$\mu g/m^3$
Mobility management	Congestion charge	Yes/no
	low emission zone	Yes/no
	Parking prices	Price of one hour of parking adjusted against cost of food (%)
	Congestion index	% of travel time lost due to congestion
	Public transport apps	Ticketing/scheduling/both
	Shared cars / sq. km	Cars / sq. km of service area
	Shared bicycles / sq. km	Bicycles / sq. km of service area
Active Mobility	Share of walking in the city	Walking trips modal share in %
	Share of cycling in the city	Cycling trips modal share in %
	Urban green cover	% of green spaces in the city

The indicators in each category have an individual score. Each indicator is ranked on an absolute scale developed for each indicator. The sum of the scores of all the indicators, in a category, gave the categorical score, and the sum of all categorical scores gave the overall score (see chapter 1).

The categorical scores were used for categorical ranking. The results for the ranking in the five categories (public transport, road safety, air quality, mobility management and active mobility) are shown in the subsequent thematic chapters 3-7.

It is important to note that this study compares the cities' sustainable mobility performance against each other. That is, a city ranking low in this sample does not necessarily mean that its urban transport performs badly at a global scale and that decision makers are not ambitious enough. For instance, most cities have well performing public transport systems.

However, the real objective should be to develop sustainable transport and mobility, which, inter alia, demands the replacement of the fossil-fuelled internal combustion

engine. Cities ranking high deliver better on their sustainable mobility objectives and are making evident strides to move away from individual motorised mobility.

Therefore, this study discusses Bucharest's rank in the five thematic areas (categories) vis-à-vis the other cities, and the reasons why Bucharest holds a certain rank in this comparison. It also highlights areas to improve transport and mobility in Bucharest.

The report "Living. Moving. Breathing. Ranking of European Cities in Sustainable Transport." (Kodukula et al. 2018) contains further information and discussion of the methodology and the data, as well as the sources of the data which have been used to generate the ranking.

3 Public Transport

Bucharest scores particularly well in this thematic area. The combination of attractiveness of public transport prices, public transport modal share and station density scores Bucharest 2nd, although annual trips per capita are moderate compared to the other capitals included in this study (see Table 3.1).

Tab. 3-1 Public transport ranking. Source: Wuppertal Institute analysis

Rank	City	Public transport share	Affordability (% of single trip ticket cost vs. daily food cost)	Annual trips per capita	Station density (stations / km^2)
1	Zurich	40%	11%	1193	7.86
2	Bucharest	36%	13%	426	8.16
3	Moscow	49%	13%	293	4.67
3	Vienna	39%	28%	511	13.00
3	Paris	40%	18%	517	6.99
3	Budapest	48%	29%	1037	1.15
7	Madrid	38%	22%	334	8.30
8	London	37%	80%	454	12.41
9	Rome	29%	18%	328	5.53
9	Copenhagen	18%	35%	512	15.23
11	Oslo	32%	28%	464	3.32
12	Brussels	28%	24%	314	2.55
13	Berlin	27%	39%	322	9.21
14	Amsterdam	17%	36%	275	8.95

Literature and experience show that attracting people to use public transport and maintaining the existing ridership of public transport depend on various factors such as the fare, coverage, frequency, comfort and reliability.

Areas for improvement

The ticket prices are very reasonable at 2.8 RON (which equals 0,59 €) for a combined suburban and urban trip (comprising two tickets for 1.3 RON and 1.5 RON, respectively). This fare is reasonable even if adjusted as a share of daily food expenditures in Bucharest. However, passengers regularly need to buy more than one ticket when using public transport.

Thus, although Bucharest ranks 2nd, it lacks an integration of different types of public transport systems (bus, urban and suburban metro). On the one hand, there is a lack of intermodal stations, combining different public transport modes, which are provided by both public and private operators; on the other hand, the city does not provide an integrated ticketing system. In this respect, the attractiveness of public transport can be increased.

To improve the attractiveness of its public transport services but also public transport modal share, the Bucharest municipality could develop an integrated ticketing system, including for instance a public transport card, that can be reloaded and used for all kinds of public transport modes.

Picture 1: Metro station

4 Road Safety

Bucharest scores 13th in this thematic area because of its unsafe traffic (see Table 4.1). The ranking takes into account the number of pedestrian fatalities in 2013 and the number of bicycle fatalities in 2017, which are the only numbers that could be retrieved (see also references section). No data was available for other years and no appropriate data was available for crashes involving injured pedestrians or cyclists.

Tab. 4-1 Road safety ranking. Source: Wuppertal Institute analysis[1]

Rank	City	Pedestrian fatalities	Crashes for 1mn pedestrian trips	Bicycle fatalities	Crashes for 1mn bicycle trips
1	Oslo	2	0.6	1	2.3
1	Copenhagen	5	0.4	5	0.7
1	Amsterdam	3	0.4	5	1.2
4	Madrid	16	2.0	1	1.6
5	Zurich	3	1.6	2	11.3
6	Vienna	11	2.7	2	7.6
7	Moscow	232	0.6	5	9.4
8	Budapest	17	1.3	2	6.7
9	Paris	23	1.5	3	10.4
10	Brussels	10	3.8	2	21.4
11	Berlin	17	2.0	15	14.3
12	London	61	2.3	8	22.3
13	Bucharest	40	1.5	3	2.5
14	Rome	47	18.4	25	15.3

In 2013, 40 individuals died through pedestrian crashes in Bucharest. In the same year, 1.5 pedestrian crashes per one million trips were reported. This latter number, however, reports accidents involving **seriously** injured persons **only**. The other 13 cities/police departments report both **seriously and lightly** injured persons. The same counting technique applies for cyclists: In Bucharest, only seriously injured cyclists are reported, leading to a low number of crashes per one million trips (2.5 seriously injured persons in 2017, see Table 4.1).

If lightly injured persons had been reported in Bucharest as well, this would have raised the number of crashes per one million trips considerably. However, official road safety data about crashes involving lightly injured persons does not exist.

The results show a strong correlation between the cities' modal share and road safety. Figure 4.1 illustrates the total active mobility share of the cities included in this study in descending order, as well as the total number of fatalities. Cities characterized by a high share of active mobility, such as Amsterdam and Copenhagen, have low numbers of fatalities, whereas cities with low rates of walking and cycling trips,

[1] In Romania, only accidents resulting in **fatalities** or in **seriously** injured persons are reported. In consequence, Table 4.1 does not include crashes with **lightly** injured persons. All other cities have reports for both seriously and lightly injured pedestrians and cyclists. In the ranking, Bucharest was assigned zero points for the two indicators which account for the total number of crashes involving injuries. As the number of seriously injured pedestrians/cyclists per one million trips in Bucharest is very high, it can be safely assumed that in Bucharest the number of lightly injured persons is very high as well (and in consequence the scoring for these two indicators very low, see references section for details).

in particular Rome and Moscow, show a reverse relation regarding road fatalities. Also Bucharest proves this assumed correlation to be true. In Bucharest, the share of non-motorised (active) modes is at 16%. In comparison to the other 13 cities, this share is relatively low, while the total number of fatalities is relatively high.

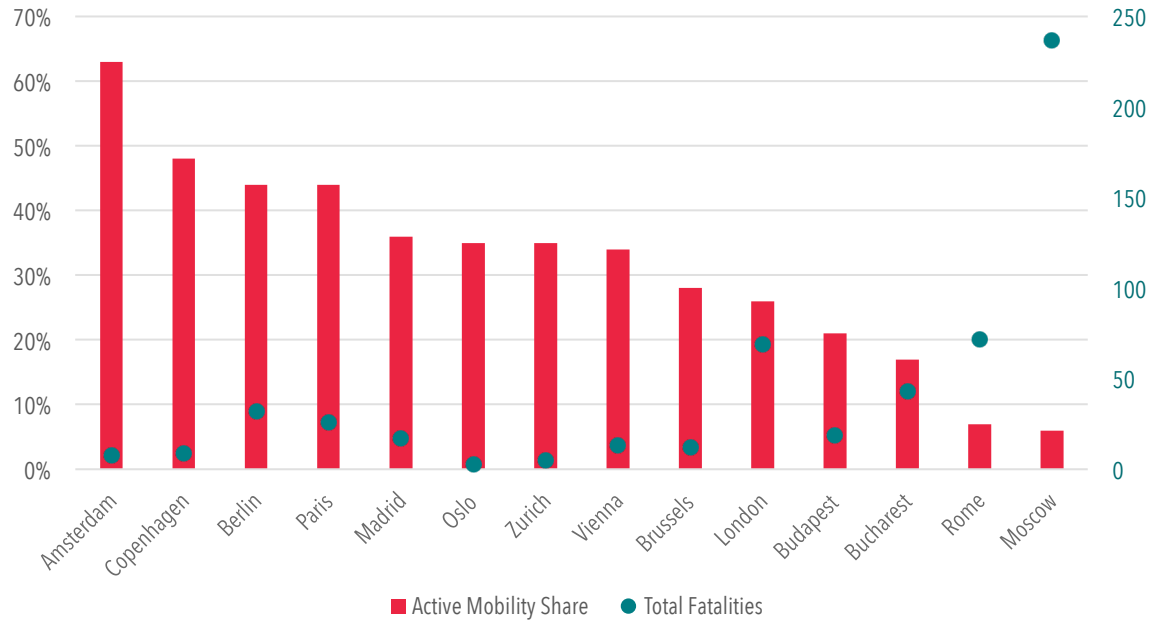

Fig. 4-1 **Correlation between active mobility trip share and fatalities. Source: Wuppertal Institute analysis**

Areas for improvement

Bucharest/Romania has developed a so-called Black Spots program which introduced a new road sign into the existing infrastructure, indicating high risk areas with above-average probabilities of road accidents. Further measures could be the introduction of speed limits at main arterials (combined with increasing the frequencies of motor vehicle checks and penalties in case of non-compliance), and education for drivers of motorised vehicles.

Speed limits are complementary to building infrastructure for pedestrian and cyclists. Safe infrastructure will not only increase the cycling and walking share, but also decrease crashes involving non-motorised modes. Meeting the demands of the most vulnerable road user groups – the elderly, children and people with reduced mobility will not only help to achieve the highest safety standards but also help all road users to profit from a much safer urban environment.

Furthermore national road safety policies such as the “Vision Zero” have great impact on local road safety. The “Vision Zero” policy is a process-oriented approach to reach a particular target – zero road fatalities. The strategies in the policy call for a more people centred road/street design. Furthermore, as the policy is approved by political decision makers, there is accountability. Norway is one of the countries which has adopted the “Vision Zero” policy, the European Union advocates this policy goal as well.

5 Air Quality

In this study, three major pollutants, namely nitrogen dioxide (NO_2), PM10 and PM2.5 were selected as indicators for air pollution since they cause the greatest harm to human health and the environment. Their values are compared to their recommended EU limit, which lies at 40 µg/m³ for NO_2 and PM10 and at 25 µg/m³ for PM2.5. The measured values are also compared to the limit set by the World Health Organisation (WHO) guideline, setting a threshold of 40 µg/m³ for NO_2, 20 µg/m³ for PM10 and 10 µg/m³ for PM2.5.

Tab. 5-1 Air quality ranking. Source: Wuppertal Institute analysis

Rank	City	Year	NO_2 annual mean	PM10 annual mean	PM2.5 annual mean
1	Oslo	2017	32.500	15.455	7.444
2	Brussels	2017	35.354	18.962	13.925
2	Copenhagen	2016	31.667	23.333	14.000
2	Vienna	2016	31.875	19.200	13.000
2	Zurich	2016	34.000	17.600	11.000
6	Amsterdam	2016	33.400	21.300	13.700
7	Madrid	2017	44.542	20.091	9.800
8	Berlin	2016	47.147	25.000	17.000
8	Budapest	2016	32.371	28.545	20.900
8	London	2017	50.800	19.400	12.400
8	Rome	2017	47.083	26.653	15.071
12	Paris	2016	49.564	26.875	16.000
13	Bucharest	2018	49.950	34.17	21.45
14	Moscow	2017	56.000	No data available	No data available

For Bucharest, the latest annual mean data of the air quality indicators was collected for the year 2018, while data for the other cities is reported for the years 2016 or 2017. The results for air quality scoring are illustrated in Table 5.1 above. Bucharest ranks 13th out of those 14 cities.

Regarding NO_2, almost half of all cities included in this analysis exceed the standards that are set by the WHO and the EU. Bucharest's annual mean concentrations of NO_2 (49.95 µg/m³) lie substantially above the EU standard, which reflects the high proportion of private motorised transport on its streets. While Moscow, London and Bucharest have the highest measured values for NO_2, Budapest, Vienna and Copenhagen have considerably lower NO_2 pollution levels, which lie also below the EU and WHO recommended standards (see Figure 5.1).

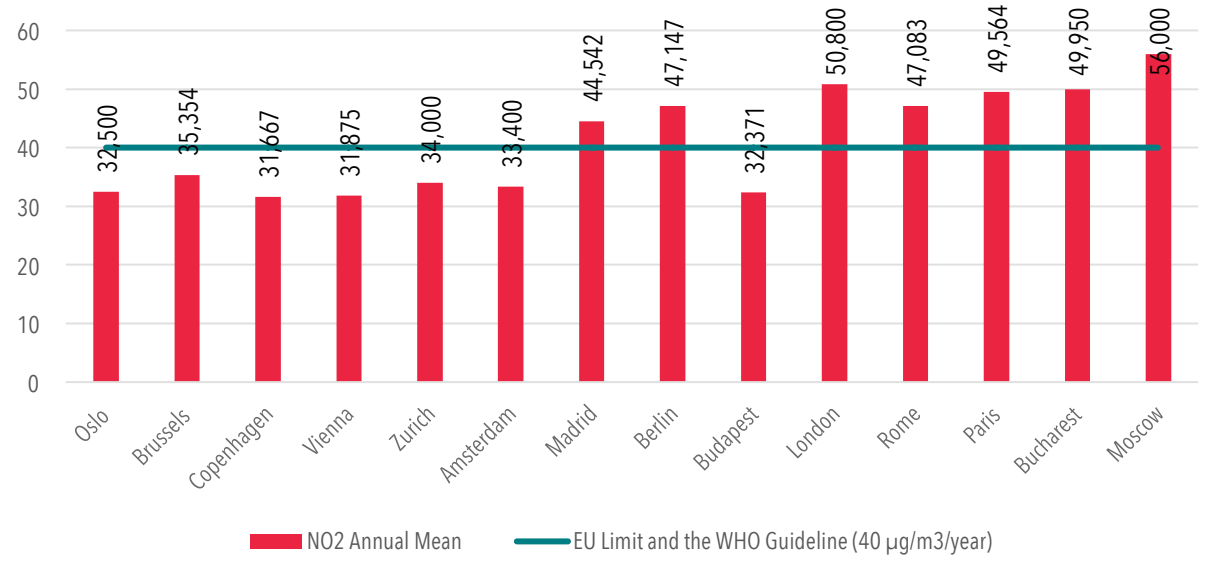

Fig. 5-1 NO_2 annual mean. Source: Wuppertal Institute analysis

Bucharest ranks last with regards to PM10 with the highest measured annual mean value of 34.17 µg/m³, exceeding also the values of Budapest (28.55 µg/m³) and Paris (26.88 µg/m³) while Oslo exhibits the lowest PM10 concentrations (15.45 µg/m³), followed by Zurich (17.60 µg/m³), Brussels (18.96 µg/m³) and Vienna (19.20 µg/m³). Figure 5.2 provides details for all cities included in the ranking.

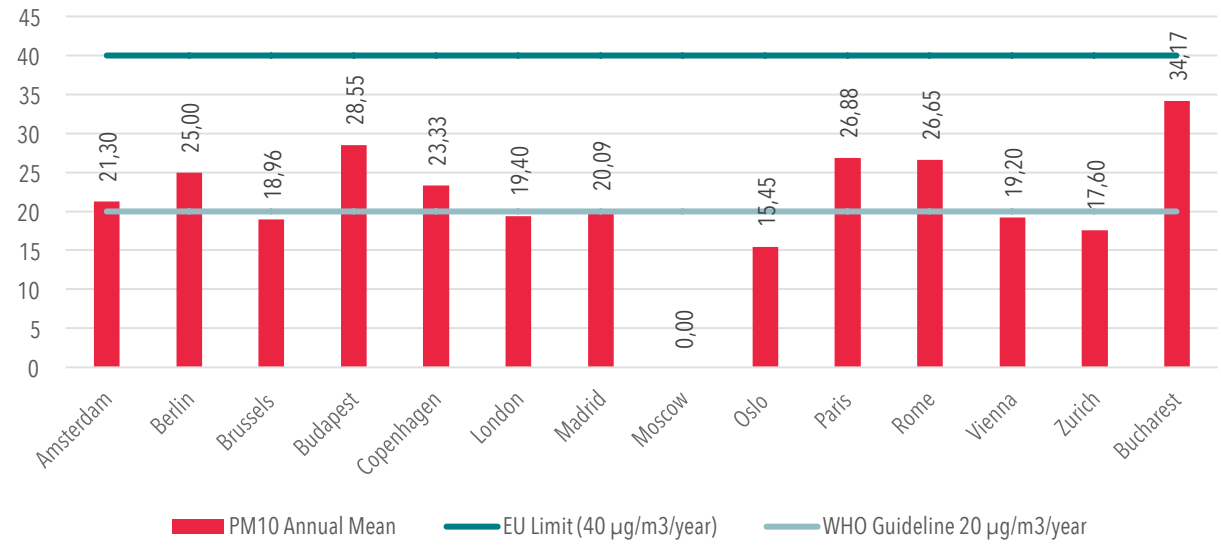

Fig. 5-2 PM10 annual mean. Source: Wuppertal Institute analysis

Bucharest has a PM 2.5 annual mean value of 21.45 µg/m³ which is, similarly to its PM10 concentrations, the highest compared to the other cities included in this study. Although it lies below the EU standard of 25 µg/m³, it considerably exceeds the maximum level recommended by the WHO guidelines (see Figure 5.3).

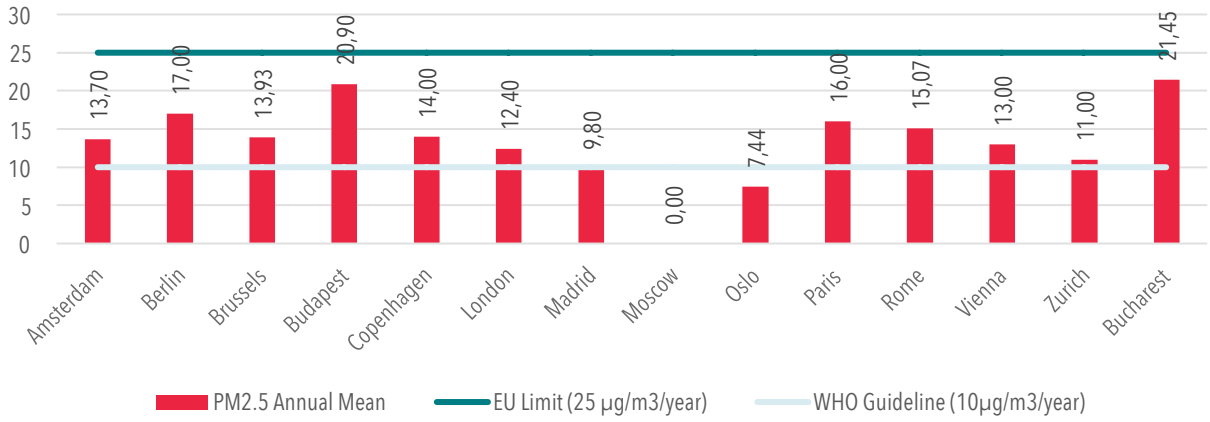

Fig. 5-3 **PM2.5 annual mean. Source: Wuppertal Institute analysis**

Thus, Bucharest shows high concentrations of air pollution as compared to the other 13 cities.

Areas for improvement

Bucharest's ranking is a result of several reasons. It exhibits the highest amounts of congestion levels among the 14 cities included (48%), with a private vehicle share of also 48%, and a relatively low active mobility share of 16%. In addition, the city has a low share of urban green areas (7.5%). In 2004, Bucharest has, therefore, introduced access restrictions regarding freight vehicles in urban areas, which, since 2005, also include vehicles over 5 tonnes during a restricted time frame (from 7.00 to 20.00 o'clock) and certain urban areas (zone A and B, including specified streets) (Urban Access Regulations n.d., Municipality of Bucharest 2004). Infringement is penalized with a fee.

The air quality of Bucharest from 2015 shows, however, that more than 48% of PM10 concentrations stems from private passenger cars whereas more than 25% of PM10 emissions stem from light-duty vehicles (Air Quality Plan of Bucharest 2015). The empirical evidence shows, hence, that measures are required at a larger scale than currently implemented in order to improve air quality levels in the city. Since the private transport sector is one of the major sources of air pollution, measures need to be addressed to reduce private car usage and to strengthen public transport, walking and cycling.

Bucharest strives to improve the situation. Low emission zones or congestion charges are not yet implemented, but the city is well aware that these may represent highly effective measures. According to a recent proposal of the city administration, a low emission zone will be implemented in different stages starting in January 2020:

- From January 2020, vehicles which do not comply with the Euro 3 norm will be banned from the city center and will have to pay a fee known as "Oxygen vignette" to enter the rest of the city, regardless of the city where they are registered.
- The same tax (Oxygen vignette) will apply for Euro 3 vehicles from 2020 and Euro 4 vehicles from 2021 to enter the city center.

- Vehicles which do not comply with the Euro 3 norm (i.e. Non-Euro, Euro 1 and 2) will be completely banned from all the streets of Bucharest starting January 2022 and Euro 3 cars starting January 2024.
- Only electric cars, hybrids or those vehicles equipped with a combustion engine which complies with either Euro 5 or Euro 6 norms will have unrestricted access to all streets in Bucharest in the year 2024 and beyond.
- However, the restrictions will only apply from Monday to Friday between 07:00 and 22:00, thus leaving exceptions for the weekend and also for public holidays.

The data provided by Bucharest city hall shows that 1,618,000 vehicles are registered in Bucharest and Ilfov county, including 261,000 non-Euro vehicles; 7,000 with Euro 1; 113,000 with Euro 2; 213,000 with Euro 3; 440,000 with Euro 4; 253,000 with Euro 5 and 331,000 with Euro 6. This means from January 2020, approximately one out of four vehicles (24%) registered in Bucharest and Ilfov county will be banned from the city center and 13% will have to pay the Oxygen vignette to access the city center.

Picture 2: Bird's-eye view on traffic

6 Mobility Management

With regard to Mobility Management, Copenhagen, London and Amsterdam are ranked best due to the combination of high hourly parking fees, accessible bike sharing systems, the availability of smartphone apps, and congestion charging schemes (present only in London). Budapest, Rome and Bucharest are positioned worst, due to high shares of personal motorised modes, low hourly parking costs, few shared mobility options as well as high congestion indices (high shares in travel time increases due to congestion).

Tab. 6-1 Mobility management ranking. Source: Wuppertal Institute analysis

Rank	City	Con-gestion charge	Share of parking cost in food price	Low emis-sion zones	Schedul-ing and ticketing apps	Increase in overall travel time	Shared cars/ km^2	Shared bikes/ km^2
1	Copenhagen	No	52%	Yes	Both	23%	9.3	21.5
2	London	Yes	80%	Yes	Both	40%	0.0	7.3
3	Amsterdam	No	60%	Yes	Scheduling	22%	4.9	14.8
4	Oslo	No	56%	Yes	Both	30%	0.6	3.9
5	Berlin	No	28%	Yes	Both	29%	3.1	6.9
5	Moscow	No	108%	No	Scheduling	44%	1.1	1.5
7	Zurich	No	17%	Yes	Both	31%	5.6	13.1
7	Madrid	No	35%	Yes	Scheduling	25%	2.6	5.5
9	Vienna	No	23%	Yes	Both	31%	1.7	3.6
9	Paris	No	38%	Yes	Scheduling	38%	5.0	19.0
11	Brussels	No	23%	Yes	Scheduling	38%	5.5	32.6
12	Budapest	No	17%	Yes	Scheduling	22%	0.3	2.8
13	Rome	No	12%	Yes	Both	40%	1.4	0.9
14	Bucharest	No	25%	No	Both	48%	0.2	13.6

Figure 6.1 shows a relationship between the share of motorised modes and parking prices adjusted for daily food expenditures. It shows that low prices for parking tend to have a positive influence on car usage. Rome with the most affordable parking has the highest share of motorised trips, followed by Bucharest with a share of 48% of motorised trips. Berlin, Brussels and Vienna with similar parking affordability, have a smaller share of motorised transport modes than Bucharest. In these cities, this results from higher shares of walking and cycling, encouraged by a safer and denser infrastructure for active mobility.

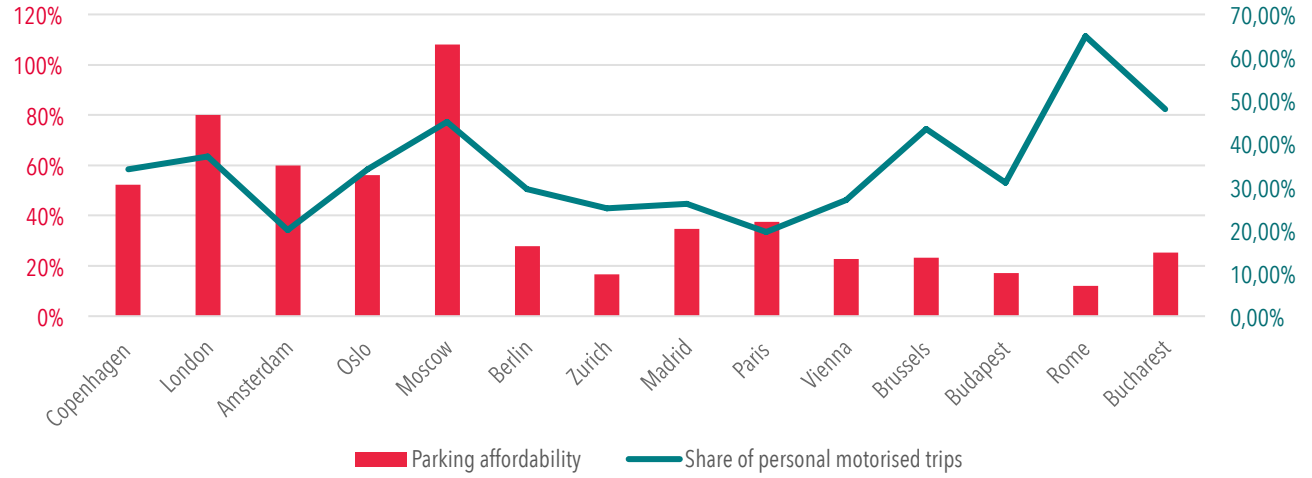

Fig. 6-1 **Correlation between parking affordability and motorised transport share. Source: Wuppertal Institute analysis**

Figure 6.2 shows the relationship between the share of motorised trips versus the number of shared bikes per square kilometre. Evidently, there is a correlation between both indicators. Cities such as Copenhagen, Amsterdam, Zurich and Paris provide relatively high numbers of shared bicycles and have, simultaneously, relatively low shares of motorised trips due to the development of an enhanced and safe cycling infrastructure.

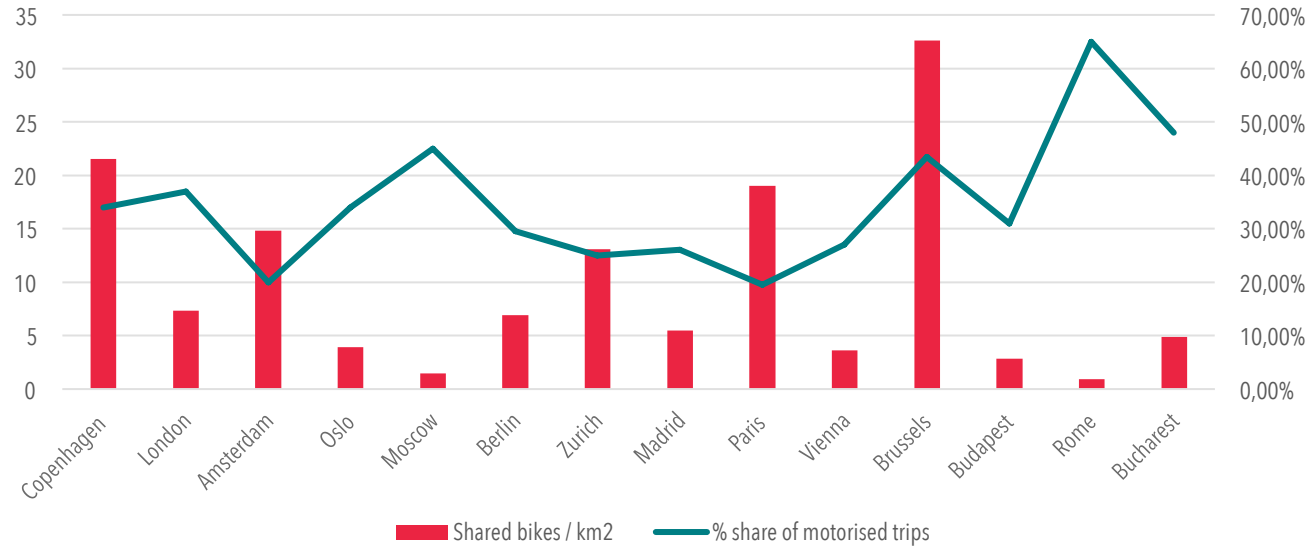

Fig. 6-2 **Correlation between number of shared bikes per km^2 and motorised transport share. Source: Wuppertal Institute analysis**

Finally, Figure 6.3 illustrates the correlation between the share of private motorised trips and the percentage increase in overall travel time due to congestion. Although Rome and Paris deviate from the main trend, high shares of private motorised transport modes are typically accompanied by high congestion levels in the respective city. Bucharest with a 48 percentage share of motorised modes shows a 48 percentage increase in travel time due to congestion on its streets; as such, it shows the

highest congestion levels among the cities analysed in this research and the second highest level with regard to its share of private motorised trips.

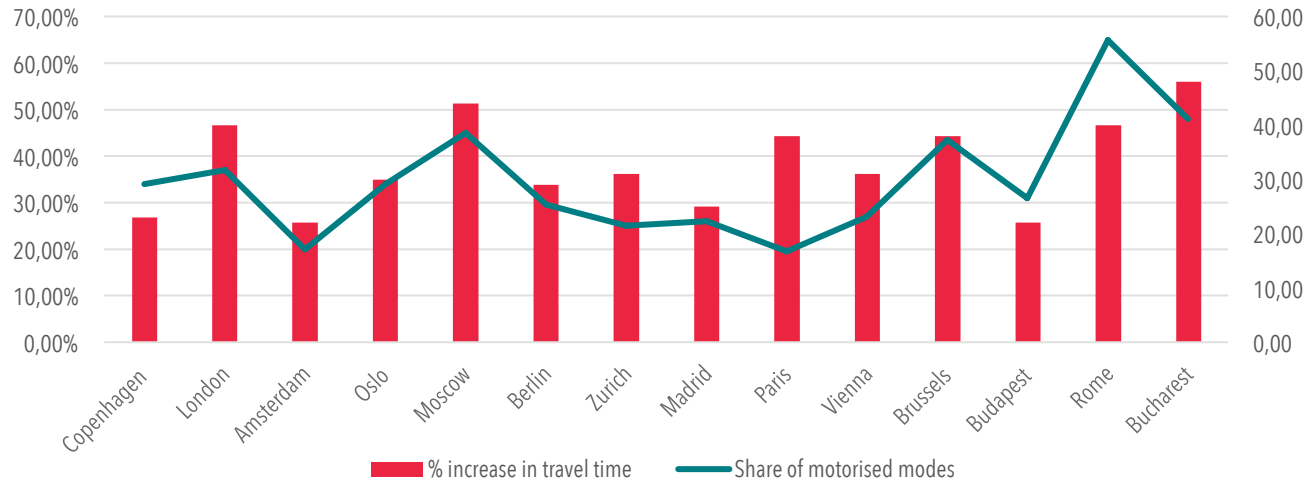

Fig. 6-3 Correlation between congestion level and motorised transport share. Source: Wuppertal Institute analysis

Since 2014, where congestion levels in Bucharest resulted in a 41% increase in travel time, the situation has worsened. The municipality has developed various strategies to combat the high traffic volume on its streets.[2]

In the first place, Bucharest has encouraged its public transport system. Although it lacks an integrated physical and administrative approach, the municipality is promoting the usage of public transport modes. This is evident when observing the 36% share of public transport in the city.

Areas for improvement

To improve the traffic situation, further policies are, however, necessary. Due to a rising level in private vehicle ownership, the development of a more efficient road network hierarchy is imperative and has the potential to channel traffic participants away from residential areas and smaller streets into major roads. Associated with that is also the development of a more efficient road network infrastructure. Moreover, Bucharest needs to develop a more efficient and comprehensive parking management system, regulating parking hours, fees, and parking slots in highly demanded areas as well as residential zones, as well as providing commuters with sustainable transport alternatives to private vehicle usage. Yet more importantly, active mobility shares must be increased and public transport modes should have traffic priority in order to decrease travel duration and hence, increase their attractiveness for passengers and commuters. The SUMP of the city Bucharest for the period 2016-2030 provides details (Avensa ROM 2015).

[2] According to a Romanian news portal, Bucharest is Europe's third most congested city and ranks 11th globally, see: https://www.romania-insider.com/bucharest-third-europe-congestion-june-2019. The underlying analysis used the same metrics as this report, namely the Tom Tom congestion index.

Picture 3: Car on sidewalk

7 Active Mobility

Bucharest scores 13th in this thematic area (see Table 7.1).

Tab. 7-1 Active mobility ranking. Source: Wuppertal Institute analysis

Rank	City	Walking share	Cycling share	Urban Green Cover
1	Amsterdam	31%	32%	28.7%
2	Copenhagen	19%	29%	22.2%
3	Berlin	31%	13%	39.7%
4	Paris	41%	3%	21.5%
5	Oslo	28%	7%	51.0%
5	Madrid	30%	6%	57.7%
7	Vienna	27%	7%	49.6%
8	Zurich	27%	8%	26.5%
9	London	24%	2%	33.5%
9	Brussels	25%	3%	33.0%
11	Budapest	19%	2%	35.0%
12	Rome	6%	1%	68.3%
13	Bucharest	15%	1%	7.5%
14	Moscow	3%	3%	7.03%

Amsterdam, Copenhagen and Berlin are ranked 1st, 2nd and 3rd, respectively, due to their cycle-friendly and pedestrian friendly infrastructure. Rome, Bucharest and Moscow are ranked last. Although Rome has the largest share of urban green space,

green areas in the city are often inaccessible, due to the lack of integration of urban planning with active mobility modes. As a consequence, Rome has very low walking and cycling shares. Bucharest and Moscow in turn have both low active mobility shares as well as a low level of green urban cover and are, thus, ranked 13th and 14th, respectively.

Areas for improvement

Pedestrian infrastructure can be improved regarding functioning and attractiveness by combatting illegal parking on sideways, eliminating obstacles on pavements, providing infrastructure that is also accessible for reduced-mobility individuals (as well as their integration into the public transport system), marking and improving intersections and pedestrian crossings, and creating pedestrian zones. With regard to bicycle infrastructure, the improvement of road safety is crucial. Introducing speed limits for motorised traffic participants, indicating bicycle lanes on shared streets, as well as creating separate bicycle lanes are relevant factors when improving bicycle infrastructure in the city.

Picture 4: Walking and cycling infrastructure

8 Conclusion: Areas of improvement

This study added Bucharest as an additional city to the ranking of 13 capitals across Europe. Bucharest was compared to the other cities with respect to public transport, road safety, air quality, mobility management and active mobility. Overall, Bucharest ranked 13th out of the 14 cities.

With respect to public transport, Bucharest ranked 2nd and proved, hence, good practices. In all other categories, however, Bucharest was ranked second-last (road safety, air quality, active mobility) or even last (mobility management). These areas are in need of improvement. However, it also has to be noted that many of the other 13 cities, which had been analysed, are well advanced in their efforts to realise a more sustainable transport system. For instance, Copenhagen is well known as cycling capital of Europe. Vienna has a public transport flat rate ticket which only costs 365 € per year - equalling one Euro per day. Paris has recently opened large areas at the River Seine exclusively for pedestrians. Similarly, Brussels has recently published its ambitious target to get rid of gasoline and diesel powered vehicles in the city by 2035.

Policies that could improve Bucharest's current transport and mobility situation should primarily tackle the high share of private motorised transport in the city. This implies for instance the introduction of congestion charges, a more efficient parking management system and the further development and upgrading of Bucharest's walking and cycling infrastructure into a more comfortable, sustainable and attractive integrated network. Higher active mobility shares translate into lower shares of privately used vehicles on the streets, less congestion, safer streets and more desirable levels of air quality.

The second place of Bucharest in the public transport thematic field is a result of attractive prices and userfriendly network. Experience shows that attracting people to use public transport and maintaining the existing ridership of public transport depend on various factors such as the fare, coverage, frequency, comfort and reliability.

To maintain and even increase its public transport attractiveness, Bucharest municipality could develop an integrated ticketing system, including for instance a public transport card, that can be reloaded and used for all kinds of public transport modes. Best practice can be found in Madrid: The publicly owned Municipal Transport Company provides an application for mobile devices, known as MaaS Madrid, which offers combined information of public transport with new complementary services of shared mobility. It brings all the mobility service providers in Madrid into a single tool, thus providing users one point of contact for multimodal travelling.

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[NOTE] For the public transport indicators, the following calculations and assumptions were applied:

The cost of a single journey via public transport services is calculated as the combined price for an urban (1.3 RON) and suburban (1.5 RON) trip, which is equal to 0.59 euros according to the current exchange rate.

The amount of annual trips per individual is calculated as the product of the number of average daily passengers and the total number of days per year (365). The resulting number of average yearly passengers is divided by the number of individuals living in Bucharest.

Station density is the result of the dividend of the total number of public transport stations, including 53 metro stations, 7 train stations and 1804 trolley and bus stations (in total, thus, 1864 public transport stations), and the geographic area measured in squared kilometres.

Indicators for Road Safety

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[NOTE] For the category road safety, the following calculations and assumptions were made:

Data on road safety varies depending on the definitions of a "crash" and a "fatality". Moreover, actual crash numbers are usually higher than official numbers, as not all crashes are reported. This report considers the years of 2013 and 2017: While data for bicycle crashes and bicycle fatalities is available for the year 2017, the only values which could be found for pedestrians are from 2013 (and retrieved from the Bucharest SUMP, see Avensa ROM 2015). No other data could be found for Bucharest.

In Romania (and hence Bucharest), only accidents resulting in **seriously** injured persons or fatalities are reported. Accidents with **lightly** injured persons are **not** reported (but in all the other countries/cities which are included in the ranking). Table 4.1 considers the numbers that are reported from official sources. In the ranking however, Bucharest scores a "0" for the two indicators which account for the total number of crashes involving cyclists and pedestrians - both indicators are meant to measure both seriously and lightly injured persons.

Reasons for the allocation of zero points for the two indicators on pedestrian and cycling crashes:

- The number of fatalities per million inhabitants is the second highest in the EU (EC 2018), only worse in Bulgaria (and the city ranking does not include a Bulgarian city).
- If the share of fatalities per all crashes in Bucharest is similar to the other 13 cities in the ranking, Bucharest receives the last (14th) place for both indicators.

Indicators for Air Quality

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[NOTE] For air quality, the following calculations and assumptions were applied:

ANPM installed five types of monitoring stations in Bucharest, including one urban station (named as B1), two stations located at roads with high traffic volume (B3 and B6), three industrial stations (B2, B4 and B5), one regional (B8) as well as one suburban (B7) station. Assuming that industrial areas as well as the regional and suburban stations are not influenced by urban traffic, the data used in this analysis stems

from three stations, namely the urban (B1) as well as the traffic stations (B3 and B6). For PM 2.5, data is only available for two stations (B1 and B6).

Indicators for Mobility Management

Traffic Index 2018. Tomtom. Retrieved from https://www.tomtom.com/en_gb/traffic-index/ranking/.

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